

Application No. 09/595,052  
Response to Office Action

Customer No. 01933

Listing of Claims:

Claims 1-39 (Canceled).

40. (New) An image processor for converting input image data having a first number of tones into halftone-processed image data having a second number of tones which is lower than the first number of tones by halftone processing, and for outputting  
5 a dot image corresponding to the halftone-processed image data, said image processor comprising:

halftone processing means for halftone-processing the input image data based on thresholds in a threshold array extending over a plurality of dither threshold planes each having a same  
10 size unit threshold matrix on which the thresholds are positioned, to produce the halftone-processed image data; and

image output means, having a first output position accuracy in a first scan direction and a second output position accuracy which is lower than the first output position accuracy in a  
15 second scan direction orthogonal to the first scan direction, for outputting the dot image, which has continuous medium-to-high tone dots in the second scan direction, in accordance with the halftone-processed image data;

wherein an order of the thresholds on the unit threshold  
20 matrix is defined based on both a reference threshold array

Application No. 09/595,052  
Response to Office Action

Customer No. 01933

indicating the order of the thresholds positioned on the unit threshold matrix on each dither threshold plane and a threshold sequence indicating correlation among the plurality of dither threshold planes with respect to the threshold array; and

25        wherein the medium-to-high tone dots are produced based on the order of the thresholds from medium to high in the unit threshold matrix, the order of the medium-to-high thresholds is of both an aperiodic array and an anisotropic array, and the anisotropic array includes neighboring thresholds having close  
30        values in the second scan direction.

41. (New) An image processor according to claim 40, wherein low thresholds in the threshold array are arranged to be dispersed isotropically in the unit threshold matrix, and the image output means outputs an image having low-tone dots which are isotropically dispersed.

42. (New) An image processor according to claim 40, wherein low thresholds in the threshold array are arranged to be dispersed anisotropically in the unit threshold matrix, and the image output means outputs an image having low-tone dots which are anisotropically dispersed.

Application No. 09/595,052  
Response to Office Action

Customer No. 01933

43. (New) An image processor according to claim 40, wherein the halftone processing means includes: (i) a first reference threshold array having low thresholds in the threshold array which are dispersed isotropically in the unit threshold matrix, and (ii) a second reference threshold array having the low thresholds in the threshold array which are dispersed anisotropically in the unit threshold matrix; and

wherein the halftone processing means selects one of the first and second reference threshold arrays according to the output position accuracy of the image output means and uses the selected reference threshold array for the halftone processing.

44. (New) An image processor according to claim 40, wherein the aperiodic medium-to-high-tone threshold array is derived from an approximation calculation model imitating output characteristics of the image output means.

45. (New) An image processor according to claim 40, wherein the anisotropic medium-to-high-tone threshold array is determined using a convolution filtering operation, and anisotropic strength is determined by adjusting a constant of the convolution filtering operation, and wherein an optimum value of the constant is determined by a diameter and a distance of lowest-tone-level dots actually printed.

Application No. 09/595,052  
Response to Office Action

Customer No. 01933

46. (New) An image processor according to claim 40, wherein the aperiodic medium-to-high-tone threshold array is set at random.

47. (New) An image processor according to claim 40, wherein the anisotropic medium-to-high-tone threshold array is set to have high anisotropy when a difference in the output position accuracy of the image output means between the first scan direction and the second scan direction is large and to have low anisotropy when the difference in the output position accuracy is small.

48. (New) An image processor according to claim 40, wherein low thresholds are a lower 20% of the thresholds of the threshold array.

49. (New) An image processor for converting input image data having M tones per pixel into a halftone-processed image data having N tones for K pixels by halftone processing, and for outputting a dot image corresponding to the halftone-processed  
5 image data, wherein K is greater than 1 and N is greater than 1, said image processor comprising:

Application No. 09/595,052  
Response to Office Action

Customer No. 01933

halftone processing means for halftone-processing the input  
image data based on thresholds in a threshold array extending  
over a plurality of dither threshold planes each having a same  
10 size unit threshold matrix on which the thresholds are positioned  
to produce the halftone-processed image data; and

image output means, having a first output position accuracy  
in a first scan direction and a second output position accuracy  
which is lower than the first output position accuracy in a  
15 second scan direction orthogonal to the first scan direction, for  
outputting the dot image, which has continuous medium-to-high  
tone dots in the second scan direction, in accordance with the  
halftone-processed image data;

wherein an order of the thresholds on the unit threshold  
20 matrix is defined based on both a reference threshold array  
indicating the order of the thresholds positioned on the unit  
threshold matrix on each dither threshold plane and a threshold  
sequence indicating correlation among the plurality of dither  
threshold planes with respect to the threshold array; and

25 wherein the medium-to-high tone dots are produced based on  
the order of the thresholds from medium to high in the unit  
threshold matrix, the order of the medium-to-high thresholds is  
of both an aperiodic array and an anisotropic array, and the  
anisotropic array includes neighboring thresholds having close  
30 values in the second scan direction.

Application No. 09/595,052  
Response to Office Action

Customer No. 01933

50. (New) An image processor according to claim 49, wherein low thresholds in the threshold array are arranged to be dispersed isotropically in the unit threshold matrix, and the image output means outputs an image having low-tone dots which are isotropically dispersed.

51. (New) An image processor according to claim 49, wherein low thresholds in said threshold array are arranged to be dispersed anisotropically in the unit threshold matrix, and the image output means outputs an image having low-tone dots anisotropically dispersed.

52. (New) An image processor according to claim 49, wherein the halftone processing means includes: (i) a first reference threshold array having low thresholds in the threshold array which are dispersed isotropically in the unit threshold matrix, and (ii) a second reference threshold array having the low thresholds in the threshold array which are dispersed anisotropically in the unit threshold matrix; and

wherein the halftone processing means selects one of the first and second reference threshold arrays according to the output position accuracy of the image output means and uses the selected reference threshold array for the halftone processing.

Application No. 09/595,052  
Response to Office Action

Customer No. 01933

53. (New) An image processor according to claim 49, wherein the aperiodic medium-to-high-tone threshold array is derived from an approximation calculation model imitating output characteristics of the image output means.

54. (New) An image processor according to claim 49, wherein the aperiodic medium-to-high-tone threshold array is set at random.

55. (New) An image processor according to claim 49, wherein the anisotropic medium-to-high-tone threshold array is set to have high anisotropy when a difference in the output position accuracy of the image output means between the first scan direction and the second scan direction is large and to have low anisotropy when the difference in the output position accuracy is small.

56. (New) An image processor according to claim 49, wherein low thresholds are lower 20% thresholds of said threshold array.

57. (New) An image processor for converting color input image data having a first number of tones into a halftone-processed image data having a second number of tones which is

Application No. 09/595,052  
Response to Office Action

Customer No. 01933

lower than the first number of tones by halftone processing and  
5 for outputting a dot image corresponding to the halftone-  
processed image data, said image processor comprising:

halftone processing means for halftone-processing the input  
image data based on thresholds in a threshold array extending  
over a plurality of dither threshold planes each having a same  
10 size unit threshold matrix on which the threshold is positioned  
to produce the halftone-processed image data, the halftone  
processing means carrying out both a first halftone processing  
using the threshold array for at least two color components and a  
second halftone processing based on an error diffusion processing  
15 for color components other than the two color components; and

color image output means, having a first output position  
accuracy in a first scan direction and a second output position  
accuracy which is lower than the first output position accuracy  
in a second scan direction orthogonal to the first scan  
20 direction, for outputting the dot image which has continuous  
medium-to-high tone dots in the second scan direction in  
accordance with the halftone-processed image data;

wherein an order of the thresholds on each unit threshold  
matrix is defined based on both a reference threshold array  
25 indicating the order of the thresholds positioned in the unit  
threshold matrix on each dither threshold plane and a threshold



Application No. 09/595,052  
Response to Office Action

Customer No. 01933

sequence indicating correlation among the plurality of dither threshold planes with respect to the threshold array; and

wherein the medium-to-high tone dots are produced based on  
30 the order of the thresholds from medium to high in the unit threshold matrix, the order of the medium-to-high thresholds is of both an aperiodic array and an anisotropic array, and the anisotropic array includes neighboring thresholds having close values in the second scan direction.

58. (New) An image processor according to claim 57, wherein the halftone processing means carries out the halftone processing using, as the threshold array extending over the plurality of dither threshold planes, a threshold array in which substantial  
5 resolutions of color components other than a yellow component are highest.

59. (New) An image processor for converting color input image data having a first number of tones into image data having a second number of tones which is lower than said first number of tones by a halftone processing and for outputting an image  
5 corresponding to the image data, said image processor comprising:

halftone processing means for carrying out the halftone processing using a plurality of threshold planes and for providing halftone-processed image data; and

Application No. 09/595,052  
Response to Office Action

Customer No. 01933

color image output means for outputting an image  
10 corresponding to said halftone-processed image data provided from  
said halftone processing means,

wherein said color input image data contains a yellow  
component; and

wherein serial thresholds for respective colors are arranged  
15 to extend over said plurality of dither threshold planes, there  
are more dither threshold planes over which said serial  
thresholds extend for yellow than for any other color, and there  
are more types of output yellow dot sizes than for other colors.

60. (New) An image processor according to claim 59, wherein  
thresholds of similar sizes are arranged on one threshold plane  
for color components other than the yellow component, and the  
serial thresholds are arranged to extend over other threshold  
5 planes near thresholds corresponding to a specific tone so as to  
prevent an image containing all single-size dots from being  
printed if a uniform input image of said specific tone is  
reproduced.